A ROUTE TO LOW POWER ION TRAP MASS SPECTROMETERS: THE TOROID MASS ANALYZER

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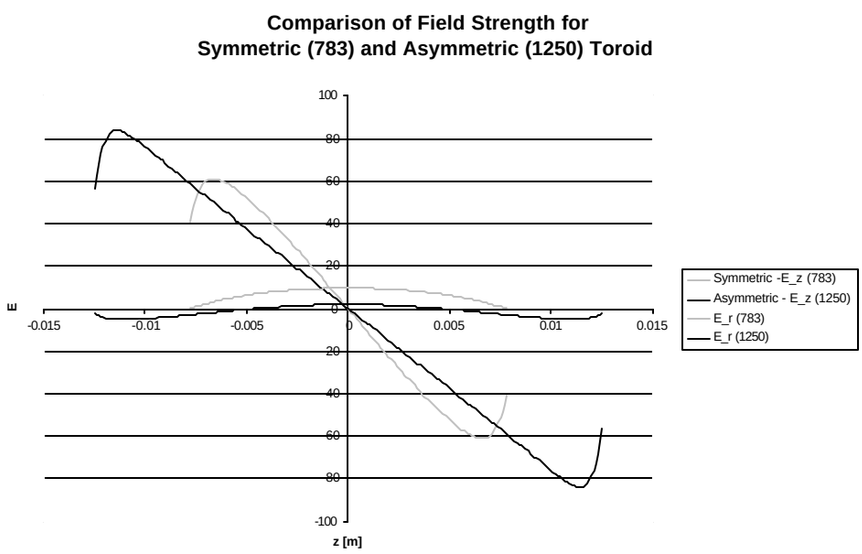
Small instrument size, simple ion optics, ultra high sensitivity, and the selectivity of MS/MS are just a few of the reasons that ion trap mass spectrometry has gained popularity for use as fieldable mass spectrometers. Efforts to further reduce size, weight and power of the ion trap are favorably governed by the inverse relationship between the analyzer radius and the amplitude of the RF trapping field. Unfortunately, smaller ion trap analyzers are more prone to the space charge performance degradation arising from ion-ion repulsion. A new ion trap analyzer geometry has been developed where the ion trapping field is in the shape of a torus. This toroidal ion trap design allows the reduction of the trapping field radius while still maintaining a large ion storage capacity.

An early version of the toroid analyzer was constructed from a standard, symmetrical ion trap cross-section. This mass analysis performance of this analyzer was characterized by broad, poorly resolved mass peaks. In this version, no attempt was made to correct for field imperfections that would be introduced from the rotation of the ion trapping field. More recently, trapping field analysis programs such as POISSON/SUPERFISH (Los Alamos National Laboratory) and ion trajectory simulation programs such as ITSIM (Purdue University) and SIMION (Idaho National Engineering Laboratory) have been used to optimize the shape and then characterize the resulting ion trapping field. The figure below shows the improvement in linearity of the axial trapping field for the toroid using an optimized asymmetric cross-section.



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